Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

\$10 membership fee, \$10 installment, and \$8.33⅓ interest and premium per month=\$28.33⅓ amount paid down.

\$1000−\$28.33⅓=\$971.66⅔ actual amount received after deducting amounts paid at time of borrowing. On this amount, \$18.33⅓ per month is paid for 74 months.

$\therefore\ 18.33\frac{1}{3}=\dfrac{971.66\frac{2}{3}r(1+r)^{74}}{(1+r)^{74}-1}$, or $18\frac{1}{3}(1+r)^{74}-18\frac{1}{3}=971\frac{2}{3}r(1+r)^{74}$.

$(1+r)^{74}-1=53r(1+r)^{74}$.

$\therefore\ (1-53r)(1+r)^{74}=1$.

$\therefore\ \log(1-53r)+74\log(1+r)=0$.

$\therefore\ r=.0137$, and $12r=.1644=16.44\%$ per annum.

128. Proposed by M. A. GRUBER, A. M., War Department, Washington, D. C.

At what time is the figure 7, on the face of a clock, midway between the hour and minute hands?

Solution by WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass.; D. G. DORRANCE, Jr., Camden, N. Y.; G. B. M. ZERR, A. M., Ph. D., Professor of Science and Mathematics, Chester High School, Chester, Pa.; and the PROPOSER.

Put $7=a=$the given figure on face of clock.

Let $x=$distance the hour hand travels after a o'clock.

Then $5a-x=$distance the minute hand travels to fulfill the condition between a and $a+1$ o'clock.

$\therefore$ As the minute hand goes 12 times as fast as the hour hand, $5a-x=12x$, and $x=\dfrac{5a}{13}$.

This is the *first* position of the hour hand after a o'clock. For, it will be observed, there are thirteen different positions in all: one after each hour and one at $2a$ o'clock.

For the *second* position, which is between $a+1$ and $a+2$ o'clock, $60+5a-x=$distance the minute hand has to travel. Whence, $60+5a-x=12x$, and $x=\dfrac{60+5a}{13}$.

Now let n represent these 13 positions of the hour hand. Then $x=\dfrac{60(n-1)+5a}{13}=$the nth position of the hour hand after a o'clock.

The time of day for the different positions is, *before* $2a$ o'clock, $5a-\dfrac{60(n-1)+5a}{13}$, or $\dfrac{60(a-n+1)}{13}$ minutes *past* $a+n-1$ o'clock; and, *after* $2a$ o'clock, $\dfrac{60(n-1)+5a}{13}-5a$, or $\dfrac{60(n-1-a)}{13}$ minutes *to* $a+n-1$ o'clock.

Substituting 7 for a, and 1, 2, 3....13, consecutively, for n, we obtain the following thirteen times of day when 7 is midway between the hour and minute hands: $32\frac{4}{13}$ minutes past 7, $27\frac{9}{13}$ minutes past 8, $23\frac{1}{13}$ minutes past 9,

$18\frac{6}{13}$ minutes past 10, $13\frac{11}{13}$ minutes past 11, $9\frac{3}{13}$ minutes past 12, $4\frac{8}{13}$ minutes past 1, 2 o'clock, $4\frac{8}{13}$ minutes to 3, $9\frac{3}{13}$ minutes to 4, $13\frac{11}{13}$ minutes to 5, $18\frac{6}{13}$ minutes to 6, and $23\frac{1}{13}$ minutes to 7.

Also solved by *JOSIAH H. DRUMMOND*, *P. S. BERG*, *ELMER SCHUYLER*, *H. C. WHITAKER*, and *J. SCHEFFER*.

129. Proposed by J. W. DAPPERT, Civil Engineer and Surveyor, Taylorville, Ill.

"A Minion, agile, in stature small
Panting came to great Diana's Hall,
Bearing a marble globe upon his shoulders,
Measuring one inch in its diameters.
He rolled it to the northeast corner of the Hall,
Left touching the northern and eastern walls;
Then following came three demi-gods in white,
Each bearing a globe of lustrous metal bright;
One of iron, copper one, and one of silver;
And they placed them in the order given,
Touching each the other, and at the same time,
Touching each the side walls, in a direct line,
The iron touching the marble, and its other side
Resting against the silver, in its glory and pride,—
All resting upon the oaken floor; and then
With heavy tread, and puff, and roar, Atlas came
Bearing a huge golden sphere, that filled the Hall,
Touching the four sides, floor and ceiling, and all
Radiant with beauty, resting against the silvery ball,
Making the globe's diameters in the room diagonal."

"Tell me, all ye who mathematics know:
What size the copper sphere, and oh!
How large the iron globe? How great
The golden globe; immaculate?
The silver sphere, how great? What size?
And if presented as a prize,
What value do you hold
Would be the sphere of gold?"

Solution by M. A. GRUBER, A. M., War Department, Washington, D. C.

A cube, in form, is great Diana's Hall:
The massive sphere of gold, admired by all,
With ceiling, sides and floor in contact is.
Within the northeast corner's boundaries
Are found the other spheres, in number four,
Each tangent to the corner's sides and floor;
Besides, the sizes of the sphere are such
That each one with its neighbor is in touch.
The order, as they to the corner rolled,
Was marble, iron, copper, silver, gold.
The hall's dimensions, length and breadth and height,
And golden sphere's diameter are quite
The same in measurement; let this be b.
The hall's diagonal, which we'll name c,
Is quickly found *b times square root of 3*. [$b\sqrt{3}$]
The points of contact of the spheres we find
Are in the hall's diagonal confined;
So, too, the centers of the spheres are there.
If hall with golden sphere we now compare,
Outside the sphere are equal ends of c;
And, known as d, each end is found to be
Square root of 3 less one times half of b. [$\frac{1}{2}b(\sqrt{3}-1)$]
The ratio of diameters to find
Of tangent spheres, must next be borne in mind.
Take a as silver sphere's diameter;